Island Community Solves Wastewater Treatment Problems

An island community solves its long-term wastewater treatment needs with a new 72,000-gpd treatment plant.

By Brent Bridges, Tom Hazlett, and Marjorie Stratton

A combination of governmental support, community involvement, innovative engineering, and skilled construction provided the right mix to solve long-term wastewater needs in the island community of Vinalhaven, ME. Its new 72,000-gpd wastewater treatment facility and collection system will, according to Maine State Senator Susan Collins, "protect the environment and bring economic opportunity to downtown Vinalhaven."

Located in Penobscot Bay and accessible by ferry from Rockland, Vinalhaven is one of only 14 Maine coastal islands that are inhabited year-round. The project is the fruit of hard work and commitment by the community, funding agencies, Maine's congressional delegation, town officials, and its consultants and contractors.

At the outset of the project six years ago, many said that building a wastewater treatment plant would be too costly, impossible to site, and that construction would be too difficult. They said there wasn't enough soil on the island to work with, and that the project would be too disruptive to everyday life in the town.

These obstacles were real, but many factors contributed to the eventual success: community commitment, resolve by the town administration, and strong interest and support by Maine's congressional delegation and funding agencies. They helped to identify project funding from both traditional and nontraditional sources, such as a U.S. Department of Agriculture Rural Development Farm Bill.

Environmental Challenges

Vinalhaven's location and geology have shaped its history and, at the same time, created challenges in meeting environmental regulations. Granite quarries that yielded stone used in building the Brooklyn Bridge and Washington Monument also left behind large areas of granite fill unsuited to subsurface wastewater treatment. With no other treatment in place, raw sewage was periodically discharged, soiling the natural beauty of Vinalhaven's harbor and causing economic and health concerns.

In the 1980s, regulatory agencies began pressuring Vinalhaven officials to find a viable solution. Initial facilities and funding plans did not meet the needs of the community and the town enlisted the services of Woodard & Curran (www.woodardcurran.com) in 1998 to develop a facilities plan for wastewater collection and treatment. The first step taken was to establish a Sewer Committee from the various stakeholders in town.

The task was to develop a solution that would be supported by the community, backed by the Maine Department of Environmental Protection (DEP), and budgeted at a cost that

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could be reasonably funded by the island residents.

Congressional leadership assisted the DEP and U.S. Department of Agriculture Rural Development in obtaining funding, and construction expertise helped minimize impacts on both year-round and seasonal residents, helping community officials reach goals for their town. These goals were that the facility would be:

- Easy to operate and maintain. Given the island's remote location and, therefore, potential difficulty in staffing a plant, getting equipment delivered and the frequent electrical outages that occur, simplicity and reliability were essential. The design incorporated primary treatment tanks to provide the level of treatment needed and reduce the attention and time an operator would need to pay to a more conventional treatment process. The primary treatment tanks treat the wastewater using anaerobic digestion. Wastewater flows through the tanks and then into the plant's biological treatment system before reaching a UV system for disinfection of the treated effluent. The biological treatment system periodically pumps back organisms that fall out of the media to the treatment tanks, which helps break down the sludge blanket even further, resulting in less frequent sludge removal.
- Reasonable to construct under island conditions. In addition to minimizing the impact on year-round and seasonal residents, and the significant ledge removal required, construction approaches also took into account the difficulty of transporting construction materials to an island. S.E. MacMillan, the construction contractor, worked around the needs of the community and implemented a streamlined construction approach that minimized the disruption, rather than the multi-staged approach, where many different areas of town are impacted, typically used for a wastewater treatment facility.
- Sludge minimization, since 100 percent of it must be hauled off the island. Limitations for onsite disposal and the difficulty in transporting sludge impacted decision-making regarding sludge disposal. The system's primary tanks require less frequent sludge management, and, in fact, eliminated the need for sludge-handling equipment, a typical component of a wastewater treatment facility. Each primary treatment tank is equipped with a sludge manifold with a 3-in. quick disconnect for a septic hauler to hook onto and pump. Pumped sludge is hauled off the island for disposal. Frequency of pumping is being determined during the course of operation.

The facility employs ultra-violet disinfection, which eliminates the need to ship to and store chemicals on the island.

Ultraviolet Disinfection

The 72,000-gpd facility serves the village area, which comprises nearly 400 users. In addition to the primary treatment system and a package secondary treatment system, the plant includes a wood-frame ultraviolet disinfection building built by the general contractor and equipped by Wedeco North America (www.pci-wedeco.com), an effluent pump station, and an ocean discharge outfall. Ultraviolet disinfection was the method of choice for Vinalhaven because it would not require the use of chemicals, thereby eliminating cost and safety concerns of shipping chemicals to, and storing them on, the island. By eliminating chemical disinfection from the treatment process, disinfection by-products are not an issue, removing concern about their impact on ocean ecosystems and the habitat.

The collection system was designed to minimize the length of collection piping and the number of pump stations, while maximizing the number of connections to existing sewer service lines. Pump stations are located at low points in the system where property was available in the right-of-way for purchase by the town. The system includes:

- 19,450 lf of 8-in. PVC gravity sewer main
- 2,710 lf of 6-in. PVC force main
- 5,370 lf of 4-in. PVC force main
- 2,260 lf of 2-in. HDPE force main
- 7,170 lf of 4-in. PVC house service connections
- 10 pump stations
- 20 grinder pump stations (Crane Pumps & Systems, www.cranepumps.com), including pressure sewer connections

Funding large infrastructure projects, particularly in rural communities, is a challenge. According to Maine's DEP Director Andrew Fisk, "It is important to recognize the work it took to get

Woodard & Curran engineer Tom Hazlett checks a trickling filter at Vinalhaven's new 72,000-gpd wastewater treatment facility.

Vinalhaven's granite riches yielded stone used in such projects as the Brooklyn Bridge and the Washington Monument.

funding. Nationwide there's a significant gap between the need and the resources available for clean water projects."

Vinalhaven was not in a position to support a multi-million dollar project, but the Maine DEP was requiring Vinalhaven to act. After a great deal of work on the part of local officials, with support from Maine's congressional delegation, adequate resources were identified. Congressional leadership was a primary factor in obtaining funding, including Maine State Representative Tom Allen and especially Senator Susan Collins.

Senator Collins and the entire congressional delegation worked to find every potential source of funding for the project, which included grants from the U.S. Department of Agriculture Rural Development, the Maine DEP, the Maine Department of Economic and Community Development, and three separate congressionally earmarked grants. With the help of these funds, the town only had to fund 12 percent of the overall cost, which was $9.8 million. Construction was begun in March 2003 and completed in July 2004. GE

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Houston Road Collapse

It started off as a typical urban pothole on Alameda Road in Houston, but soon grew big enough to swallow a full-size car, about 60 ft by 40 ft. It closed the road for months, disrupted local businesses, and cost about $10 million to repair.

With infrastructure coming of age, failures of existing systems and even complete collapse of deteriorated pipe and structures are not hard to find. With over 100 miles of large diameter monolithically cast-in-place (MCIP) pipe, Houston is no stranger to this phenomenon. The recent development of a sinkhole led to an intensive investigation of the existing conditions to develop a design that would provide a long-term solution to the ongoing problems.

The sewer line along Almeda Road was originally installed in a tunnel around 1978. Repairs were made in 1991 when 330 ft of HOBAS (www.hobaspipe.com) centrifugally cast, fiberglass-reinforced, polymer mortar (CCFRPM) pipe was used to fix a damaged area. During 1993 and 1994, much of the line was internally or externally grouted in an effort to extend the life of the line. This was done to seal the line and combat soil compaction.

Even though the line was 40 to 43 ft below the ground surface and 30 ft below the groundwater table, evidence of the problem was reaching the surface. The damage to the pavement and surrounding area was proof that the problems were getting worse. Another indication of an interceptor leak was erratic flow to the Almeda Sims Wastewater Treatment Plant.

On November 5, 2002, a sinkhole appeared and emergency repairs were made. But damage continued to escalate as a nearby water line was broken by the loss of support as the soil strength continued to weaken. Ultimately, the affected area was so large that two lanes of Almeda Road had to be closed and traffic rerouted.

Houston took quick action to assemble and coordinate a team to repair the Almeda Road cave in. The city chose Pate Engineers (www.pateeng.com) as consulting civil engineer. Tolunay-Wong (www.tweinc.com) as geotechnical consultant, BRH Garver (www.brhgarver.com) as contractor, and HOBAS as the pipe supplier. They were brought together to find a solution. J. E. Pate, Jr., principal at Pate Engineers, explained that years of groundwater infiltration had carried fine soils through small cracks in the 84-in. MCIP pipe and this weakened and compromised the native soil to the point of failure. As the embedment worsened, additional cracks developed, causing more infiltration and continuing the vicious cycle.

The area adjacent to the collapse was stabilized, dewatered, and a liner plate shaft was constructed. Next, the flow was rerouted using 3,000-gpm bypass pumps. To assess the extent of the problem, the 28,000 ft of existing interceptor was evaluated and inspected by closed circuit TV. Areas that were in need of sliplining were subsequently cleaned in preparation for rehabilitation. The sliplining pipe, which was 72-in. in diameter with a pipe stiffness of 46 psi, was used in several locations adjacent to the sinkhole and the liner plate shaft. The sliplined section included lengths of 1,700 ft, 360 ft, and 370 ft in the problem areas.

Ground penetrating radar was used to determine where the soil strength was compromised and future settlement might be expected. Soil grouting and underpinning were required in this area to give the embedment adequate strength to support the pipe. In the location of the sinkhole itself, HOBAS 72 stiffness FWC coupling pipes were also installed by direct bury. The total repairs included one-half mile of CCFRPM pipe.

The consulting engineer had the opportunity to inspect the 1991 installation and found no evidence of leaks. The new pipe installation was also inspected with remote TV cameras, again revealing no evidence of leakage. In less than a year after the first sinkhole appeared, the team was assembled, the situation evaluated, designed, repaired, and all four lanes of Almeda Road were back in service. GE